REMARKS

Claims 1 to 4 and 7 to 27 are pending. Claims 1 and 17 are independent.[1] Favorable reconsideration and further examination are respectfully requested.

In the Office Action, the claims were restricted as follows:

> In accordance with 37 CFR 1.499, applicant is required, in reply to this action, to elect a single invention to which the claims must be restricted.
> Group I, claim(s) 1-16, drawn to a method of operating an electrochemical fuel cell.
> Group II, claim(s) 17-27, drawn to electrochemical fuel cell assembly.
>
> 2. The groups of inventions listed above do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: The common technical feature between the two groups is a fuel cell assembly with fuel flow channels within the anode, cathode, and delivering a sufficient quantity of liquid water to the flow channels within the cathode. This is not a special technical feature because Breault et al. (US 6316135) discloses a fuel cell assembly with fluid flows channels for the anode, cathode, and delivering sufficient quantity of liquid water to the flow channels within the cathode [Abstract] (9:33-64) therefore a lack of unity exist between the groups *a posteriori*.

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[1] The Examiner is urged to independently confirm this recitation of the pending claims.
[2] Office Action, page 2

We hereby affirm, with traverse, the election of claims 1 to 16. In this regard, we submit that there is unity of invention for this application under PCT Rules 13.1 and 13.2. More specifically, PCT Rule 13.2 states

> Where a group of inventions is claimed in one and the same international application, the requirement of unity of invention referred to in Rule 13.1 shall be fulfilled only when there is a technical relationship among those inventions involving one or more of the same or corresponding special technical features. The expression "special technical features" shall mean those technical features that define a contribution which each of the claimed inventions, considered as a whole, makes over the prior art.

For the claims amended above, there is a relationship among the inventions of Groups I and II, which involve one or more of the same or corresponding special technical features. As stated in the rule, a special technical feature means "technical features that define a contribution which each of the claimed inventions, considered as a whole, makes over the prior art".
In this case, the independent claims of both Groups I and II include features similar to the following:

> wherein delivering the sufficient quantity of liquid water comprises:
> determining, for each of a plurality of currents, a maximum voltage for the one or more fuel cells as a function of liquid water flow rate, the each of a plurality of currents being within a normal range of operating conditions of the one or more fuel cells;
> determining a calibration function expressing a minimum liquid water flow rate as a function of current and/or air stoichiometry, the minimum liquid water flow rate being based on a corresponding maximum voltage; and
> delivering at least the minimum liquid water flow rate for a corresponding current drawn from the one or more fuel cells and/or for the air stoichiometry, the delivered minimum liquid water flow rate being determined by the calibration function.

As explained below, it is our belief that these features define over the art of record and, therefore, qualify as a special technical feature according to PCT rule. Accordingly, we respectfully request withdrawal of the restriction.

Next, the claims were rejected as follows:

Claim Rejections - 35 USC § 112

4. Claims 1-16 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claim 1, the use of the term "substantially" makes it unclear and indefinite as to what portion of the fluid flow channels meet the limitations.

Regarding claims 4, 9, 10, 11, and 12, the use of the term "water factor" is unclear and indefinite as this parameter is not readily recognized. For the purposes of examination any apparatus that provides a sufficient quantity of water will be defined as providing the "water factor" required.

All claims dependent are also rejected for the same.

As shown above, the word "substantially" has been removed from the claims. As for "water factor", that term is clearly described in the specification. For example, page 12 of the original PCT application explains:

> It is helpful to describe the quantity of water delivered to the cathode as a multiple of the theoretical minimum amount required for evaporative cooling, i.e. a 'water factor' WF is hereby defined in which:
>
> $$WF = m_w / m_w(\text{minimum})$$
>
> where m_w is the mass flow rate of liquid water delivered, and $m_w(\text{minimum})$ is the theoretical minimum mass flow rate of liquid water as calculated below.

Accordingly, we submit that "water factor" is clear in the claims, and respectfully request withdrawal of the foregoing rejection.

Turning to the art rejections, claims 1 to 3 and 7 to 16 were rejected over WO00/63992 (Brambilla) in view of U.S. Patent Publication No. 2003/0186093 (St-Pierre); and claims 4 to 6 were rejected over Brambilla and St-Pierre in view of U.S. Patent No. 6,524,733 (Nonobe). As shown above, features similar to former dependent claim 6 were incorporated into both independent claims 1 and 17.

In particular, claim 1 now recites:

> 1. A method of operating an electrochemical fuel cell stack comprising a plurality of fuel cells, each of the fuel cells comprising an anode, an ion transfer membrane, and a cathode, the method comprising:
> delivering fluid fuel to one or more fluid flow channels in each anode of one or more fuel cells in the electrochemical fuel cell stack;
> delivering fluid oxidant to one or more fluid flow channels in each cathode of the one or more fuel cells;
> exhausting reaction by-products and unused oxidant from the one or more fluid flow channels in each cathode of the one or more fuel cells; and
> delivering a sufficient quantity of liquid water to the one or more fluid flow channels in each cathode of the one or more fuel cells such that a relative humidity of 100% is maintained throughout the one or more fluid flow channels in each cathode of the one or more fuel cells;
> wherein delivering the sufficient quantity of liquid water comprises:
> determining, for each of a plurality of currents, a maximum voltage for the one or more fuel cells as a function of liquid water flow rate, the each of a plurality of currents being within a normal range of operating conditions of the one or more fuel cells;
> determining a calibration function expressing a minimum liquid water flow rate as a function of current and/or air stoichiometry, the minimum liquid water flow rate being based on a corresponding maximum voltage; and
> delivering at least the minimum liquid water flow rate for a corresponding current drawn from the one or more fuel cells and/or for the air stoichiometry, the delivered minimum liquid water flow rate being determined by the calibration function.

The applied art is not understood to disclose or to suggest at least the foregoing underlined features of claim 1.

In this regard, the Office Action states the following with respect to claim 6:

> Regarding claims 4-6, Brambilla and St-Pierre are silent towards increasing the quantity of water delivered as a function of fuel cell current and determining a calibration function based on current.
>
> Nonobe teaches a fuel cell system that determines a precise condition of the humidification of the electrolyte membrane of the fuel cell based on the current and voltage of the fuel cell so that adjustments (calibration function) can be performed so that the humidification of the electrolyte membrane remains within a proper range [Abstract] (2:3-46). It would have been obvious to one of ordinary skill in the art at the time of the invention to determine and control the condition of the humidification of the electrolyte membrane of Brambilla and St-Pierre because Nonobe teaches this provides precise condition information to maintain the humidification in a proper range.
>
> [3]

Nonobe describes the following:

> a fuel cell system having a polymer electrolyte type fuel cell formed by stacking unit cells, each of which has an electrolyte membrane sandwiched by two electrodes, the system including a fuel gas supplier that supplies a fuel gas to the fuel cell, a fuel gas humidifier that humidifies the fuel gas, a current detector that detects an electric current outputted from the fuel cell, a resistance detector that detects a resistance of the fuel cell, and a humidification condition determiner that determines a condition of humidification of the electrolyte membranes based on the current detected by the current detector and the resistance detected by the resistance detector.[4]

Figs. 4 to 7 of Nonobe show humidification determining routines, which are executable to determine a humidification condition of the fuel cell. The routine shown in Fig. 4, for example, takes into account an output current of the fuel cell and the resistance of the fuel cell in order to determine whether there is proper humidification in the fuel cell.[5] The routine shown in Fig. 5, for example, takes into account the the current and voltage of the fuel cell in order to determine

[3] Office Action, page 7
[4] Col. 2, lines 4 to 16 (emphasis added)
[5] See, e.g., col. 8, lines 46 et seq.

whether there is proper humidification in the fuel cell.[6] Figs. 6 and 7 depict additional routines for determining the humidification of the fuel cell, which take into account the voltage of the fule cell. However, while the routines do take into account votlage and/or current, they do not disclose or suggest determining a calibration function expressing liquid water flow rate as a function fo current and/or air stoichiometry, much less delivering at least the minimum liquid water flow rate determined using the calibration function. Rather, the routines of Nonobe are simply used to determine the amount of humidification, and then other processes are used to correct the humidification (see, e.g., col. 6, lines 33 to 48 and col. 7, lines 10 to 25 for examples of those processes). Furthermore, Nonobe is silent regarding air stoichiometry.

For at least the foreoging reasons, independent claim 1 is believed to be patentable over the applied art. Independent claim 17 is also believed to be patetnable over the applied art for at least the reasons explained above.

Dependent claims are also believed to define patentable features. Each dependent claim partakes of the novelty of its corresponding independent claim and, as such, each has not been discussed specifically herein.

It is believed that all of the pending claims have been addressed. However, the absence of a reply to a specific rejection, issue or comment does not signify agreement with or concession of that rejection, issue or comment. In addition, because the arguments made above may not be exhaustive, there may be reasons for patentability of any or all pending claims (or other claims) that have not been expressed. Finally, nothing in this paper should be construed as an intent to concede any issue with regard to any claim, except as specifically stated in this

[6] See, e.g., col. 9, lines 52 et seq.

paper, and the amendment of any claim does not necessarily signify concession of unpatentability of the claim prior to its amendment.

In view of the foregoing remarks, we respectfully submit that the application is in condition for allowance, and such action is respectfully requested at the Examiner's earliest convenience.

The undersigned attorney can be reached at the address shown below. All telephone calls should be directed to the undersigned at 617-521-7896.

Please apply any other charges or credits to deposit account 06-1050.

Respectfully submitted,

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